Energy scenarios for the Netherlands to 2030 - Summary

Background

This study has its origins in the Sustainable Energy Action Plan drawn up by Netbeheer Nederland, the association of Dutch power and gas grid operators. During a kick-off roundtable meeting with stakeholders on 27 November, 2013, participants expressed a need for a set of robust scenarios for the overall Dutch energy supply up to 2030. Netbeheer Nederland commissioned CE Delft and DNV GL to elaborate such scenarios.

Scope and goal

The scenarios seek to give parties involved in the design and operation of the Netherlands' future energy supply a broad and solid discussion framework covering social, financial and technical aspects. The scenarios developed provide insight into alternative development trajectories, by detailing their financial, social and technical parameters. The results of the study are to serve as a springboard for further debate on future developments and issues in the energy supply. The study identifies areas requiring collective focus in the years ahead, with a view to elaborating effective strategies and solutions.

It is a macro-economic modelling study that encompasses the entire Dutch energy system (electricity, heat, transport fuels), specifically the energy-related use of energy sources. From a set of defined horizons for the year 2030, scenarios were backcasted to the present, to identify the steps that will need to be taken in the intervening years, the barriers that will need to be tackled and the sacrifices that will have to be made along the way.

The present study is *not* intended as an optimisation study to ascertain an optimum design for the county's future energy supply. Thus, no attempt has been made to optimise the utilisation and dimensioning of generating and storage facilities, for example. The choices and assumptions made in the study are based on today's knowledge and expertise, with the primary aim of establishing the outer perimeters of tomorrow's playing field: the space within which reality will unfold.

Elaboration

For each scenario, two models were used to quantify the basic contours of the 2030 horizon: aggregate energy flows, required grid and generating capacities, and associated costs. Backcasting was then performed for the years 2024 and 2018, interpolating back to the initial year of the study, 2012, the most recent year for which data are available.

Costs were estimated on the basis of a Business-as-Usual (BAU) scenario incorporating anticipated trends, including pledges under the Energy Agreement for Sustainable Growth. The costs of the other scenarios were calculated relative to this BAU scenario.

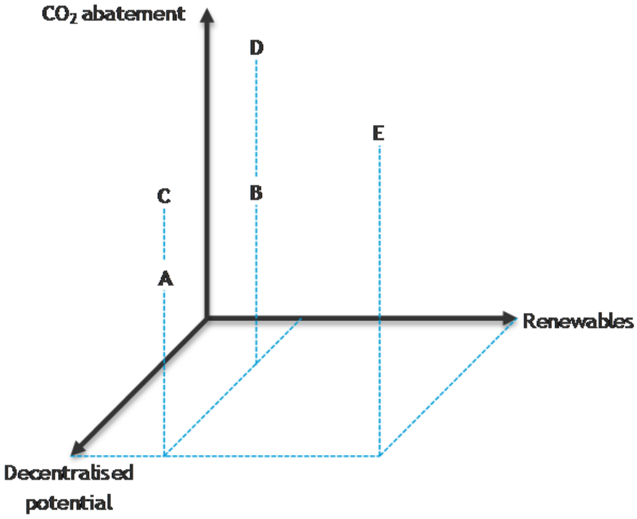
In the course of the study two stakeholder meetings were held, so input and commentary could be given on the project's assumptions and provisional results. These commentaries have been incorporated in the present report.

Horizons

The five 'horizons' for the year 2030 differ in three primary features defined by the project principal and stakeholders: share of renewables, utilisation of decentralised production potential and CO_2 abatement. Figure 1 locates the horizons on these three axes. Additionally, the horizons differ in their absolute energy savings and the amount of decentralised generating capacity installed.

Oude Delft 180
2611 HH Delft – The Netherlands
t +31(0)15 2 150 150
www.cedelft.eu ce@ce.nl
Besloten Vennootschap (Ltd.)
KvK 27251086 Chamber of Commerce

Figure 1 The five scenarios positioned on three axes



The horizons for 2030 were defined by working back through the various steps from functional energy demand (demand for heat and power) to primary energy demand and filling in the respective data. The functional energy demand is the same for all five horizons, so the results can be compared on the basis of the adopted modelling assumptions and are unaffected by exogenous trends, such as deviating figures on population growth or economic growth. The differences in energy efficiency, production mix and conversion efficiency lead ultimately to the horizons satisfying the set features.

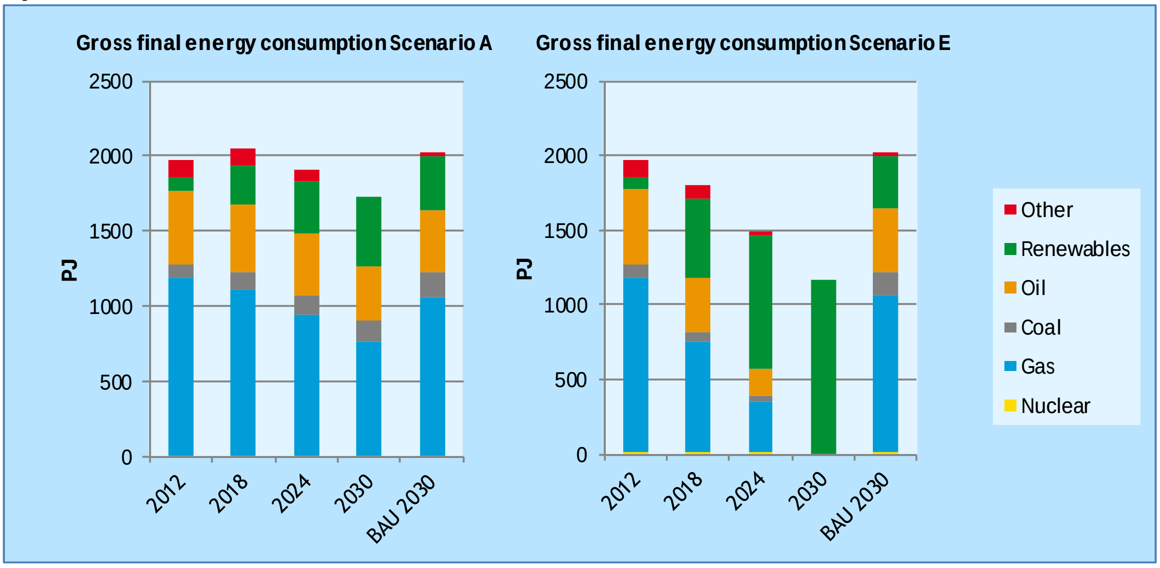
Table 1 Horizon features

Horizon	CO_2 emission cuts	Renewables	Decentralised potential
A	40%	25%	100%
B	40%	25%	<25%
C	55%	25%	100%
D	100%	25%	<25%
E	100%	100%	100%

Scenarios

For each of the five scenarios, demand for electricity, high and low temperature heat and transport fuels were then calculated and translated to ultimate gross final energy consumption, as illustrated in Figure 2 for two scenarios, A and E.

Figure 2 Results for Scenarios A and E



Analysis

The scenarios were analysed with respect to:

- reliability of supply;
- sustainability;
- barriers;
- costs;
- grid consequences.

The results of the cost calculations are shown in Table 2. These figures make allowance for the fact that measures implemented in 2029, for example, will continue to impact for many years. These future effects have thus been included, for both costs and benefits, as applicable.

Table 2 Results of cost calculations for the five scenarios (present value relative to BAU, billion €)

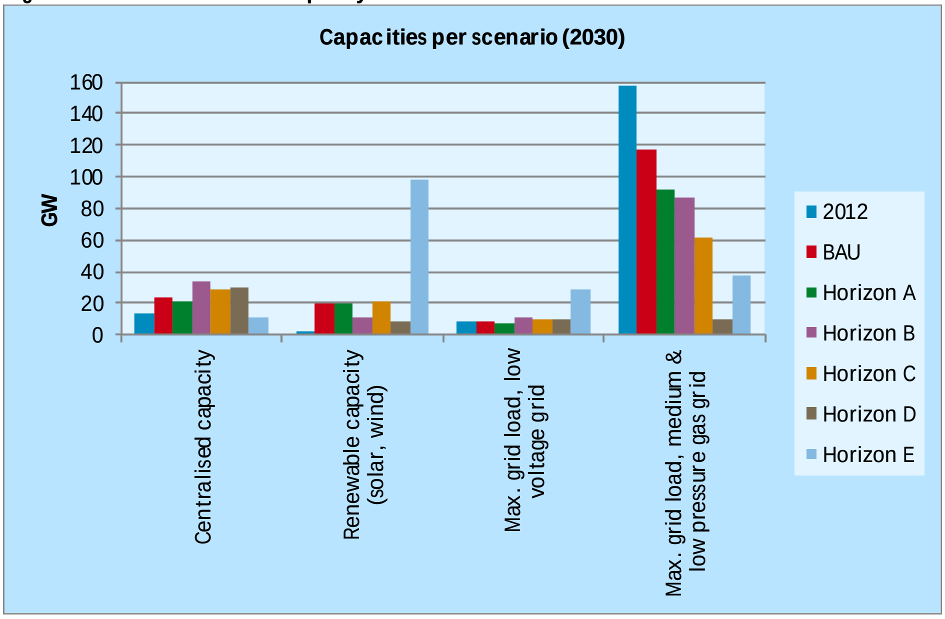
	Scenario A		**Scenario B**		**Scenario C**		**Scenario D**		**Scenario E**	
	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits
Centralised power generation		3	18		10		31			5
Decentralised power generation		4		8		2		16	96	
Heat production (gas)		0	2			1		2		3
Heat production (elect.)	1		14		15		35		20	
Storage and H_2 production	0			1	0		6		71	
Transmission/distribution (elect.)		5	9		3		8		11	
Energy and CO_2		21		9		38		81		94
Energy efficiency measures	38		2		41		131		130	
Motor fuels		22		3		33		88		96
Vehicles		2		2	1		13		15	
Result	**19**		**-23**		**5**		**-37**		**-146**	

Note: The reported data make due allowance for continued savings and O&M costs after 2030.

Besides financial aspects, consequences for the power and gas grids were also estimated. Improved energy efficiency and shifts among energy sources mean that grid loads change in the various scenarios. Input of major quantities of (hard-to-control) electricity from decentralised units such as solar PV will have major consequences for the low voltage grid, and its capacity will need to be substantially expanded to handle peak output from such units. Alternatively, large-scale decentralised storage will be need to be created.

A robust reduction of heat demand and substitution by alternative forms of heating will lead to a reduction in the maximum grid load for the medium and low pressure natural gas grid (<8 bar).

Figure 3 Selected results of capacity calculations



Conclusions

Major changes in our energy systems will be required over the coming decades if the contours of the scenarios for 2030 are to materialise. Some of these changes are already in motion, but most are still to come. The chosen horizons and the scenario calculations show the effects of these changes: changes in the ratio between centralised and decentralised capacity, greater use of renewables and electrical power, the potential for load management, and more feedback between supply and demand for electrical power, gas and heat.

From the present study the following conclusions emerge:
- Without appropriate action, there will be problems maintaining electricity system balance and voltage quality.
- Today's energy market is unprepared for decentralised capacity on any significant scale.
- There is a need for tariff systems that incentivise final users to improve the match between energy supply and demand.
- There is a need for new earning models for (re)investment in conventional and renewable capacity and in local initiatives and projects.
- There will be increasing disparity between the costs borne by households investing (able to invest) in solar PV and those that do not.
- Today's market model for energy-efficient technologies is not fit-for-purpose.
- Energy service flexibility can be improved through system-wide use of ICT.
- New technologies lead to high costs for society if these are socialised.
- Scenario trends as well as major developments in gas transport and distribution require a rethink of the role of today's gas infrastructure.

Recommendations

From the analyses and calculations of the present study eleven recommendations have been drawn up, to help guide the further debate on the Netherlands' future energy supply and the role of its energy infrastructure.

1. Draw up and implement robust energy efficiency regulations.
2. Design regulations and market mechanisms that can accommodate flexible demand and production.
3. Identify options for cheap(er) storage systems and optimum storage utilisation, alongside curtailment of solar PV and joint use of infrastructure.
4. Develop a market model and market regulations that facilitate the required energy mix (more renewables) and harmonise with policies and legislation in neighbouring countries.
5. Develop a new approach to power supply reliability and new business models for investment in conventional and renewable generating technologies.
6. Develop local stakeholder processes for reinvestment in low pressure gas grids.
7. Develop new business models for investment in heat grids.
8. Carefully monitor trends in the transport sector in order to harmonise interactions with the electricity sector.
9. Develop a market for sustainable biomass.
10. Debate the pros and cons of flexible tariff systems.
11. Develop funding instruments to facilitate the transition.